

Design Review

Manufacturing plan

The PCB fabrication and assembly will be outsourced to an external manufacturer

1. To obtain economies of scales, approximately 0.5m squared can be processed in one batch
2. Each layer must be fabricated and tested separately so it adds a fixed cost per layer
3. Board designer prepares layout using a CAD system to define copper tracking layers, soldermasks and component notations.

To Fabricate pattern of copper tracks on a single layer:

4. Laser photoplotters used to make the films to image the PCBs which takes the board data and converts it into a pixel image.
5. Panel of laminate is used to produce the inner layers of the multilayer PCB
6. For each layer, the copper-coated laminate is coated with photoresist on both sides
7. A powerful UV lamp is used to harden the photoresist where the copper is to remain
8. An Alkaline solution is used to remove unhardened photoresist and unwanted copper
9. The hardened photoresist is finally removed and copper track is produced

Next Process:

10. Each layer is inspected automatically by a camera and compared with the design files to detect defects
11. Layers are bonded together with epoxy and a thin copper foil
12. Holes are drilled and metal plated to link copper layers together
13. Outer layers are plated, covered in protective epoxy and text labels
14. Automated electrical testing is carried out
15. Board is finally cut into two hundred 50mm x 50mm individual PCBs
16. A team of inspectors give each PCB a final careful each-over
17. No calibration is needed as tolerances are within +/- 0.1%
18. They may check the output voltage variation with varying inputs, check corner conditions within datasheet values, check if both 5V and 10V are working, check that the max current is 20mA with a load, check short circuit conditions and finally test temperature conditions.

Recurring Costs

Material	Quantity	Unit Price £	Total Price £
uA723CD	400	0.401	160.4
Resistor 22Ω +/- 0.1%	400	0.153	61.2
Resistor 4990Ω +/- 0.1%	200	0.24	48
Resistor 2150Ω +/- 0.1%	200	0.24	48
Resistor 4870Ω +/- 0.1%	200	0.516	103.2
Resistor 7150Ω +/- 0.1%	200	0.24	48
Capacitor 1uF +/- 10%	200	0.0938	18.76
Capacitor 100pF +/- 5%	400	0.0195	7.8
Technician (£20/hour) - Fabrication, Packaging & Testing	400 Hours	20	8000
PCB Assembly	2200	0.1	220
PCB	200	1.15	230

Total recurring costs = £8945.36, per PCB = £44.73

Component prices are taken from Farnell, RS and Mouser electronics.

Risk and Contingencies Analysis

Risk	Approach	Financial Impact (£)	Probability	Contingency (£)
1. Voltage regulator unavailable so may not acquire for 200 PCBs in time	Find 3 component manufacturers, otherwise design with another component	12k	0.1	1200
2. Components (resistors etc) are not available	Find 3 component manufacturers, otherwise design with other components	12k	0.05	600
3. Unskilled design engineers available for hire	Increase the potential salary to attract skilled staff	50/hr	0.2	120
4. Injury of staff - Electrical shocks or burns etc	Safe working environment	3k	0.1	300
5. Damage to PCBs	Alter PCB board	4k	0.1	400

Total Contingency cost = £2620, per PCB = £13.10

	Impact of Occurrence					
		1	2	3	4	5
	5					
	4	3				
	3		4,5		1	
	2			2		
	1					

Total Cost per Power Supply

Non-Recurring Costs:

Material	Quantity	Unit Price £	Total Price £
Photomasks	1	6000	6000
Design Engineer Salary	80 hrs	40	3200
Computer Systems and Support Staff	2	1000	2000
Test Equipment – Power supply	2	300	600
Test Fixtures/Probes	2	100	200

Total non-recurring costs = £12000, per PCB = £60

Ideal case total cost per unit = £44.73 + £12000/200 = £104.73

Total cost per unit = £44.73 + (£12000+£2620)/200 = £117.83